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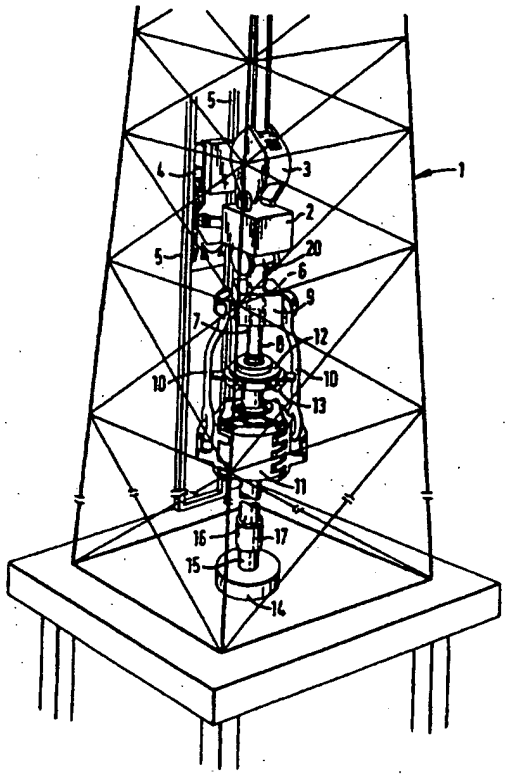
(54) Title: METHOD AND APPARATUS FOR CONNECTING AND DISCONNECTING TUBULARS

(57) Abstract

A top drive (2) is employed to connect two stands of casing (15, 16). In the preferred embodiment, the top drive (2) is connected to a telescopic drive shaft (6) which has a head (12) which can be clamped onto the casing (16). The torque applied to the connection can be controlled by controlling the current or hydraulic pressure applied to the top drive (2). The main elevator (11) is supported by a pair of bails (10) which are suspended from a support block (9) fast on the upper section (7) of the telescopic drive shaft (6).



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Method and Apparatus for Connecting and Disconnecting Tubulars

This invention relates to a method and apparatus for connecting and disconnecting tubulars.

During the construction of oil and gas wells a hole is bored into the earth. Lengths of casing are then screwed together to form stands and lowered into the bore, inter alia to prevent the wall of the bore collapsing and to carry oil or gas to the surface.

After each stand of casing has been lowered into the bore slips are applied which support the casing whilst the next stand of casing is screwed into the casing in the slips. When the new stand of casing is connected to the casing in the slips the slips are released and the new stand lowered into the bore. This process is repeated until the desired length of casing has been lowered into the bore.

It is important that the joints between the lengths of casing are tightened to the correct torque both to render the joint leakproof and to ensure that the casing will not part.

Historically, lengths of casing were originally connected using manually operated tongs. Later these were replaced by power operated tongs which were manoeuvred into position manually. More recently automatic tongs have been introduced which run on rails and can be advanced towards a joint or withdrawn therefrom by remote control.

Whilst power tongs have proved satisfactory for use with standard casing having a diameter up to 16 inches, it is now becoming more common to employ casing with a diameter of from 18 5/8" to 36".

Although automatic tongs have been built to accommodate such casing they are extremely heavy and extremely expensive.

One aspect of the present invention provides a simple and relatively inexpensive alternative.

In particular, one device for rotating a drill string during drilling is known as a top drive. Top drives are generally hydraulically or electrically operated.

According to one aspect of the present invention there is provided a method for connecting tubulars, which method comprises the step of rotating one tubular relative to another with a top drive.

According to another aspect of the present invention there is provided an apparatus for use in a method in accordance with the present invention, which apparatus comprises a head for gripping a length of casing and a drive shaft which extends from said head and is rotatable by a top drive.

Preferably, said drive shaft is telescopically extendible.

Advantageously, said drive shaft is hollow and includes an upper section and a lower section and wherein said apparatus further includes a packer actuable when said drive shaft is fully contracted to provide a seal between said upper section and said lower section. This arrangement enables a casing to be circulated quickly and efficiently should it jam whilst being lowered down a hole.

In one embodiment, a chamber is provided which can be pressurized to contract said drive shaft.

Advantageously, said head comprises a plurality of jaws and a plurality of actuators for urging said jaws into engagement with said casing.

Preferably, the apparatus includes a support block for supporting a main elevator.

Advantageously, the apparatus includes a pair of bails and a main elevator wherein said bails are mounted

on opposite sides of said support block and said main elevator is connected to said bails.

If desired, a joint may be provided to enable the head to be pivoted to facilitate handling the stands of casing. A universal joint is preferred although this is not essential.

The present invention also provides a top drive provided with an apparatus in accordance with the present invention.

* * *

For a better understanding of the present invention reference will now be made, by way of example, to the accompanying drawings, in which:-

Fig 1 is a perspective view of one embodiment of a drilling rig provided with a top drive and an apparatus in accordance with the present invention;

Fig 2 is a view of a detail of a second embodiment; and

Fig 3 is a side view of a third embodiment of part of a drilling rig provided with a top drive and an apparatus in accordance with the invention.

Referring to the drawing, there is shown a drilling rig which is generally identified by reference numeral 1.

The drilling rig 1 comprises a top drive 2 which is supported by a travelling block 3. The top drive 2 is mounted on a carriage 4 which is slidably mounted on rails 5.

A telescopic drive shaft 6 is connected to the bottom of the top drive 2 and comprises an upper section 7 and a lower section 8 which are provided with interengaging internal and external splines respectively.

The telescopic drive shaft 6 extends through a bore in a support block 9 which is suspended from the top drive 2 by a hollow tubular member 20. Two bails 10 are disposed to opposite sides of the support block 9 and support main elevator 11.

The lower section 8 of the telescopic drive shaft 6 is connected to a head 12 which comprises six gripping jaws (not shown) which are actuable by respective hydraulic rams 13.

In order to lower casing into the top drive 2 is first raised close to the top of drilling rig 1. A stand of casing 15 is then moved into position by ancillary handling equipment such as an auxiliary elevator or

a pipe handling device and gripped by main elevator 11.

The stand of casing is then lowered into the bore by lowering the top drive 2. When the top drive 2 reaches its lowermost position slips 14 are applied to prevent the casing 15 falling down the bore. Main elevator 11 is then disconnected and raised to the top of the drilling rig 1.

A new stand of casing 16 is then moved into axial alignment with the casing 15 by the pipe handling device.

Top drive 2 is then lowered until the head 12 surrounds the socket on the top of the stand of casing 16. The top drive 2 is then lowered a further few cm (typically 10 to 20 cms) during which time the lower section 8 of the telescopic drive shaft 6 enters the upper section 7.

The hydraulic rams 13 are then applied to urge a plurality of jaws (not shown) into engagement with the head 12. The main elevator 11 is placed around the casing 11 but is NOT moved into gripping engagement with the casing 16 at this stage.

The pipe positioning device is then lowered to allow the bottom end of the stand of casing 16 to enter the socket 17 on the top of the casing 15.

Top drive 2 is then actuated to rotate the telescopic drive shaft 6, the head 12 and the casing 16. As the casing 16 enters the socket 17 the lower section 8 slides downwardly relative to the upper section 7 and relative to the main elevator 11 which does not rotate with the telescopic drive shaft 6.

During this time the pipe handling device may be released or lowered in a controlled manner to inhibit damage to the threads. Alternatively, vertical movement of the pipe handling device may be controlled by a pneumatic cylinder which simply compresses as the casing

16 enters the socket 17.

If the top drive 2 is electric the torque applied to the joint can be limited by limiting the maximum current to the top drive 2. Similarly, if the top drive 2 is hydraulic the torque applied to the joint can be limited by limiting the maximum pressure of the hydraulic fluid.

Once the casing 16 is tightened to the required torque the main elevator 11 is firmly applied to the casing 16 and the head 12 disconnected. Slight upward pressure is applied to the casing 16 by raising the top drive 2 slightly to enable the slips 14 to be released.

The top drive 2 is then lowered until the casing 16 occupies the position initially occupied by the casing 15 at which time the process is repeated.

Various modifications to the arrangement described are envisaged, for example the upper section and the lower section of the telescopic drive shaft could be biased together by compressed air at the start of a coupling operation. The pressure could then be slowly reduced to allow the casing 16 to gently enter the socket 17 without damaging the threads. Figure 2 shows a simplified detail of such an arrangement.

Referring to Figure 2, the telescopic drive shaft 6' comprises an upper section 7' and a lower section 8' which are biased together by compressed air introduced into chamber 18 via hose 19.

Prior to lowering the head 12 onto a new stand of casing the chamber 18 is pressurised with compressed air to fully contract the telescopic drive shaft 6. The top drive 2 is then lowered until the head 12 is circumjacent the casing 15. The hydraulic rams 13 are then actuated.

A small amount of air is then allowed out of the chamber 18 to allow the pin on the bottom of casing 16

to enter the socket 17 and lightly bear on the threads therein.

When the top drive 2 is rotated the casing 16 enters the socket 17 and the pressure in the chamber 18 increases as the casing 16 moves downwardly. The pneumatic cushion provided by the compressed air in chamber 18 allows the joint to be made with minimal risk of damage to the threads. Conveniently hose 19 coils around the upper section 7' as the joint is made.

If desired the support block 9 could form part of the housing of the top drive 2.

Turning now to Fig 3, top drive 2" is suspended from travelling block 3". Support block 9" is bolted directly to the housing of top drive 2" and is provided with ears for accommodating bails (not shown).

A drive shaft extends downwardly from the top drive 2" to universal joint 21" which in turn supports telescopic drive shaft 6" which comprises an upper section 7" provided with external splines and a lower section 8" which is provided with internal splines and which is fast with head 12".

The universal join 21" allows the head 12" to be pivoted to facilitate the connection of stands of casing.

A further refinement of this embodiment is that, above the external splines the upper section 7" is provided with an inflatable packer 22". In addition, the drive shaft 6" is hollow.

If the casing jams whilst it is being lowered the slips are applied. The main elevator is then relaxed and travelling block 3" lowered. The head 12" engages the top of the casing and the upper section 7" of the drive shaft 6" enters the lower section 8" until the inflatable packer 22" lies inside the lower section 8". The inflatable packer is then inflated.

Mud is then pumped down the well via a hose 23, the drive shaft of the top drive 2" (which is hollow), a flexible hose (not visible) extending across the universal joint 21", and through the hollow drive shaft 6".

A resilient annular sealing member 23" is also provided to form a seal between the head 12" and the top of the socket on the casing.

The purpose of pumping mud down the hole is to try and free any blockage. After pumping has been continued for a given period, for example 10 minutes, the flow of mud is stopped.

The travelling block 3" is then raised until the main elevator is just below the socket. The main elevator is then applied to the casing and is then raised to enable the stops to be released. The travelling block 3" is then lowered. If the blockage has not been cleared the slips are re-applied and the procedure repeated.

Claims

1. A method for connecting tubulars, which method comprises the step of rotating one tubular relative to another with a top drive.

2. An apparatus for use in a method according to Claim 1, which apparatus comprises a head (12) for gripping a length of casing (16), and a drive shaft (6) which extends from said head (12) and is rotatable by a top drive (2).

3. An apparatus as claimed in Claim 2, wherein said drive shaft (6) is telescopically extendible.

4. An apparatus as claimed in Claim 3, including a chamber (18) which can be pressurized to contract said drive shaft (6).

5. An apparatus as claimed in Claim 3 or 4, wherein said drive shaft (6") is hollow and includes an upper section (7") and a lower section (8") and wherein said apparatus includes a packer (22") actuable when said drive shaft (6") is fully contracted to provide a seal between said upper section (7") and said lower section (8").

6. An apparatus as claimed in Claim 2, 3, 4 or 5, wherein said head (12) comprises a plurality of jaws and a plurality of actuators (13) for urging said jaws into engagement with said casing (16).

7. An apparatus as claimed in Claim 2, 3, 4, 5 or 6, including a support block (9) for supplying a main elevator (11).

8. An apparatus as claimed in Claim 7, including a pair of bails (10) and a main elevator (11) wherein said bails (10) are mounted on opposite sides of said support block (9) and said main elevator (11) is connected to said bails (10).

9. An apparatus as claimed in any of Claims 2 to 7,

including a joint (21"), which enables said head (12") to be pivoted.

10. A top drive provided with an apparatus as claimed in any of Claims 2 to 9.

FIG. 1

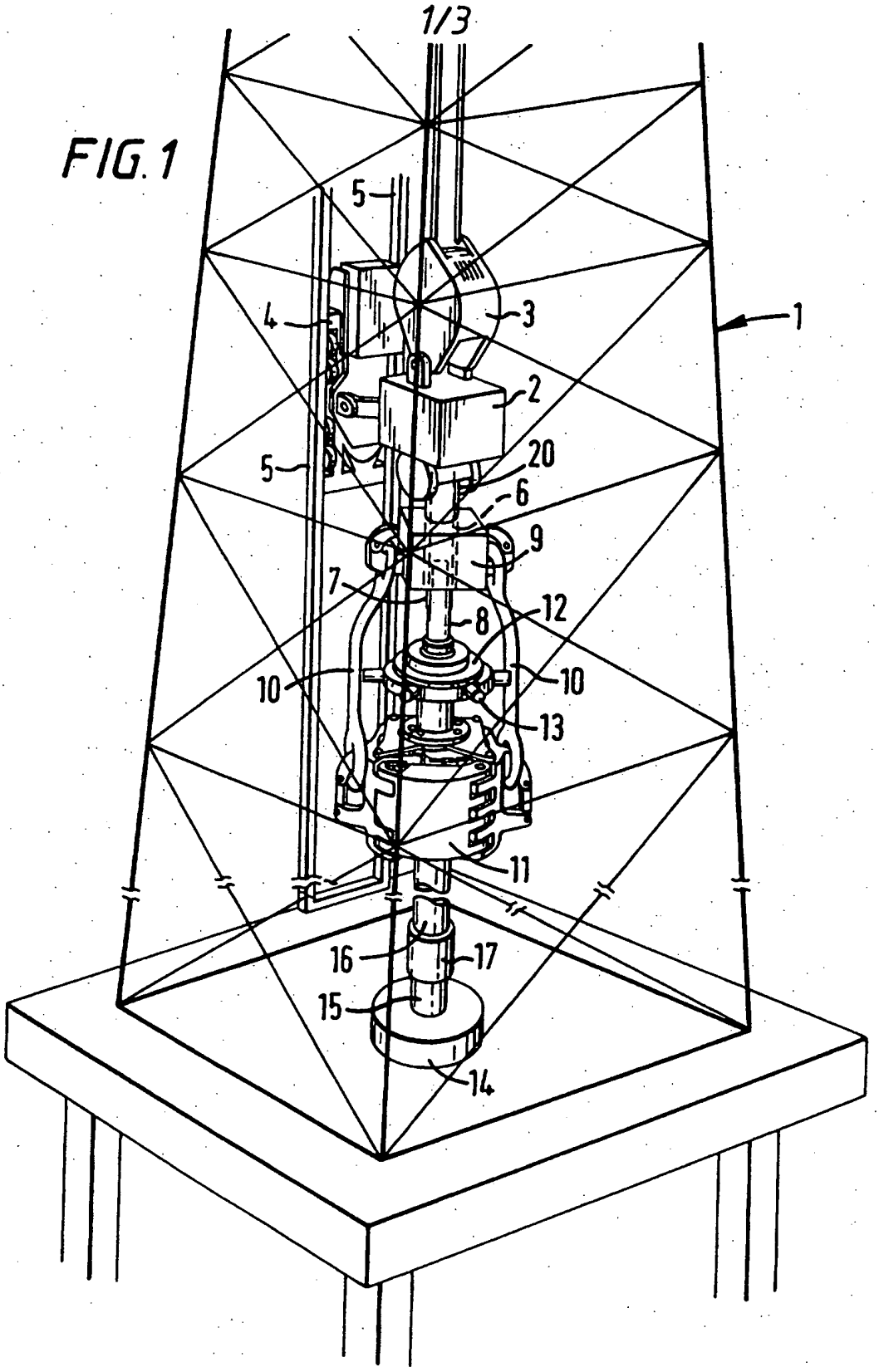


FIG. 2

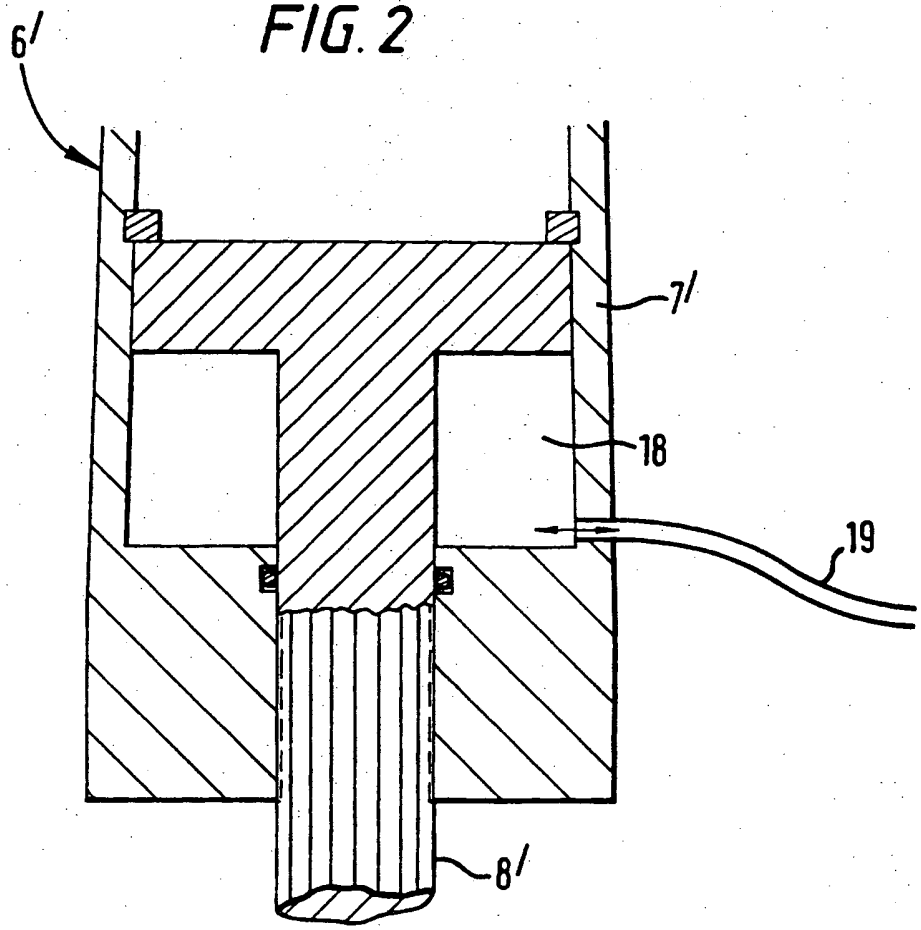
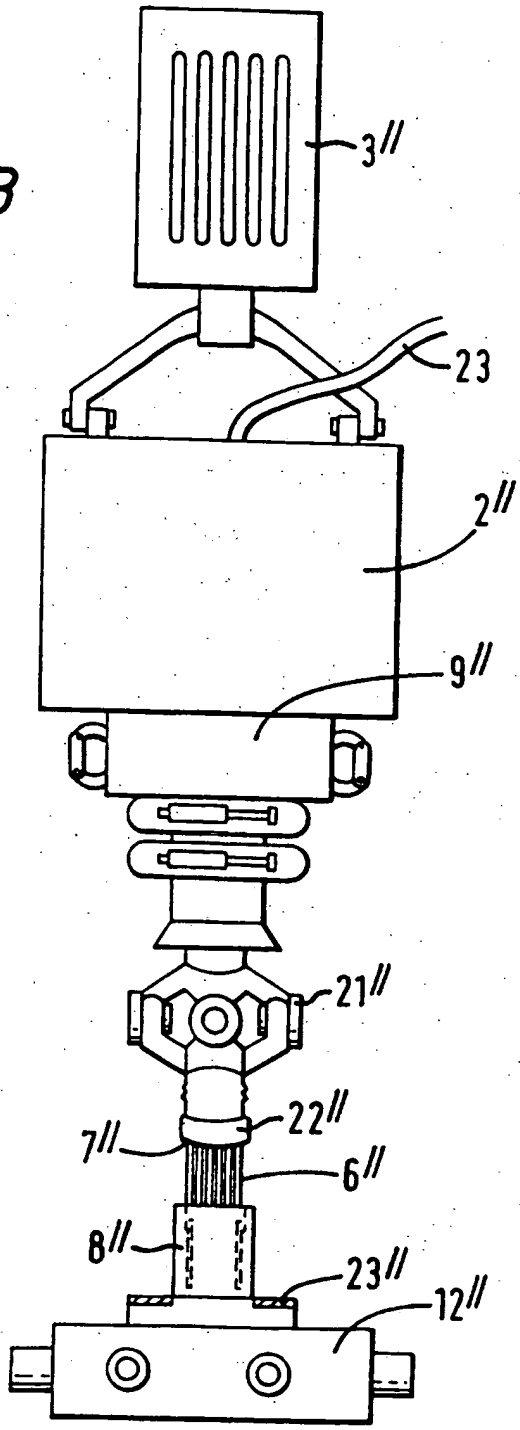


FIG. 3



INTERNATIONAL SEARCH REPORT

Internat Application No
PCT/GB 95/02953

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 E21B19/16 E21B17/07

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

WPI, Full text EP, WO, GB, CH, FR, DE, US, TULSA

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	US,A,5 036 927 (WILLIS) 6 August 1991 see column 4, line 25 - line 39; figures 1,2	1,2,6,10
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[X] Further documents are listed in the continuation of box C.

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Date of the actual completion of the international search	Date of mailing of the international search report
2 May 1996	09.05.95

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

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